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(19) (CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Cable as Suspension Means for Lifts

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Notice: This application is as filed and may therefore contain an incomplete specification.

Summary:

This cable (1) has suspension means for lifts, which is connected with a cage (13) or load-receiving means, consists of synthetic fibres. A sheathing (2) surrounds an outermost strand layer (3). The sheathing (2) consists of synthetic material, preferably of polyurethane. Strands (4) are twisted or laid of individual aramide fibres (5). Each individual strand (4) is treated with an impregnating medium for the protection of the fibres (5). A friction-reducing intermediate sheathing (7) is arranged between the outermost strand layer (3) and the inner strand layer (6). In order to obtain and almost circularly shaped strand layer (6) and increase the degree of filling, gaps are augmented by filler strands (9). The task of the sheathing (2) consists in assuring the desired co-efficient of friction to the drive pulley and to protect the strands against mechanical and chemical damages and ultraviolet rays. The load is in that case carried exclusively by the strands (4). The cable (1) built up of aramide fibres (5) by comparison with a steel cable displays a substantially higher carrying capacity and only one fifth to one sixth of the specific weight for the same cross-section.

(Figure 2)

Description:

Cable as suspension means for lifts

The invention concerns a cable as suspension means for lifts, which is connected with a cage or load-receiving means, wherein the cable consists of synthetic fibres.

Until today, steel cables were used in lift construction, which are connected with the cages or the load-receiving means and counterweights, in the simplest case in the ratio of 1:1. The use of steel cables however entails some disadvantages. Due to the high own weight of the steel cable, limits are set to the lifting height of a lift installation. Furthermore, the co-efficient of friction between the metallic drive pulley and the steel cable is so low that the co-efficient must be increased by different measures such as special groove shapes or special groove linings in the drive pulley or through enlargement of the looping angle. Beyond that, the steel cable acts as a sound bridge between the drive and the lift cage, which entails a reduction in the travelling comfort. In order to reduce these undesired effects, expensive constructional measures are required. Moreover, steel cables by comparison with the synthetic fibre cables stand a lower number of bending cycles, are exposed to corrosion and must be maintained regularly.

An inlay ring for the lining of the wire cable grooves of cable rollers for cable railways and lifts, which consists of elastic material for the damping of the noises and for the preservation of the wire cables, has become known by the CH-PS 495 911. In order to assure a better removal of the internal heat, the inlay ring is built up of several individual segments spaced one from the other. The expansion of the inlay ring, that has taken place in consequence of heating, is compensated for by the spacings between the individual segments. On loading by the wire cable, the elastic material can deviate into the incisions and is thereby relieved to a certain extent so that also no tears arise in the cable groove. In the case of local wear of the inlay ring, individual segments must be exchanged.

In the case of the aforedescribed invention, a steel cable is still used as suspension means which displays the initially mentioned disadvantages. Furtheremore, the elastic inlay is worn greatly due to the small length of the running surface of the cable roller in relation to the length of the steel cable and must thus be replaced frequently, which entails high maintenance costs.

The invention is based on the object of proposing a cable as suspension means for lifts of the initially named kind, which does not display the aforementioned disadvantages and by means of which the travel comfort is increased.

This problem is solved by the invention characterised in the patent claim 1.

The advantages achieved by the invention are to be seen substantially in that a sheathed synthetic fibre cable, which consists of several layers and the strands of which are untreated or treated by an impregnating medium, by comparison with steel cables displays a substantially higher carrying capacity and is almost free of maintenance.

Advantageous developments and improvements of the synthetic fibre cable indicated in claim 1 are possible through the measures mentioned in the subclaims. The sheathing of the synthetic fibre cable produces higher co-efficients or friction on the drive pulley so that the looping can be kept smaller. The co-efficient of friction can be influenced by a different property of the sheathing surface. Thereby, the drive pulleys can be standardised, since no different groove shapes are needed any longer. For steel cables, the drive pulley diameter must amount to forty times the cable diameter. On the use of synthetic fibre cables, the drive pulley diameter can be chosen to be significantly smaller by reason of their properties. Synthetic fibre cables by comparison with steel cables permit a substantially greater number of bending changes for the same diameter conditions. Due to the low weight of the synthetic fibre cable by comparison with a steel cable, apart from a reduction in the number of balancing cables, a substantially lower tensioning weight can also be used. Due to the aforementioned improvements, a smaller required starting torque and turning moment results for the design of the drive, which consequently lowers the starting current or the energy requirement. Thereby, the drive

motors let themselves be reduced in their overall size. Moreover, no frequency transmissions take place in a cable of this mode of construction so that an excitation of the cage by way of the cable disappears, which apart from an increase in the travelling comfort also permits a reduction in the constructional measures for the isolation of the cage.

An example of embodiment of the invention is illustrated in the drawing and more closely explained in the following. There show:

Figure 1	a section through a synthetic fibre cable according to the invention,
Figure 2	a perspective illustration of the synthetic fibre cable according to the invention,
Figure 3	a schematic illustration of a lift plant,
Figure 4	a schematic illustration of a lift plant with a suspension of 2:1 and
Figure 5	in cross-section, a detail of a drive pulley with a synthetic fibre cable according to the invention lying thereon.

Figure 1 shows a section through a synthetic fibre cable 1 according to the invention. A sheathing 2 surrounds an outermost strand layer 3. The sheathing 2 of synthetic material, preferably polyurethane, increases the co-efficient of the cable 1 on the drive pulley. The outermost strand layer 3 must display so high binding forces to the sheathing 2, that this does not displace or forms upset portions due to the shear forces arising on loading of the cable 1. These binding forces are achieved in that the synthetic material sheathing 2 is sprayed (extruded) on so that all intermediate spaces between the strands 4 are filled out and a large retaining surface is formed. The strands 4 are twisted or laid of individual aramide fibres 5. Each individual strand 4 is treated with an impregnating medium, for example polyurethane solution, for the protection of the fibres 5. The bending fatigue strength of the cable 1 is dependent on the proportion of the polyurethane at each strand 4. The higher the proportion of the polyurethane, the higher becomes the bending fatigue strength. However, the carrying capability and the modulus of elasticity of the synthetic fibre cable 1 falls with increasing proportion of

polyurethane. The polyurethane proportion to the impregnation of the strands 4 can according to desired bending fatigue strength lie for example between 10 and 60%. Expediently, the individual strands 4 can also be protected by a braided sleeve or polyester fibres.

In order to avoid a wear of the strands by mutual friction one against the other on the drive pulley, a friction-reducing intermediate sheathing 7 is applied for that reason between the outermost strand layer 3 and the inner strand layer 6. The same friction-reducing effect can be achieved by the treatment of the strands 4 lying thereunder by silicone. Thereby, the wear is kept low at the outermost strand layer 3 and at the inner strand layers 6, which during the bending of the cable perform most of the relative movements at the drive pulley. Another means for the prevention of frictional wear at the strands 4 could be an elastic filler mass which connects the strands 4 one with the other without too greatly reducing the flexibility of the cable 1.

Other than pure holding cables, lift cables must be very compact and firmly twisted or braided in order that they do not deform on the drive pulley or start to turn in consequence of their own twist or deflection. The gaps and hollow spaces between the individual layers of the strands 4 are therefore filled out by means of filler strands 9, which can act in supporting manner against other strands 4, in order to obtain an almost circularly shaped strand layer 6 and to increase the degree of filling. These filler strands 9 consist of synthetic material, for example of polyamide.

The aramide fibres 4 consisting of high-grade oriented molecule chains display a high tension strength. By contrast to steel, the aramide fibre 4 however has a rather low lateral strength by reason of its atomic build-up. For this reason, no conventional steel cable joints can be used for the cable end fastening of synthetic fibre cables 1, since the clamping forces acting in these components greatly reduce the breaking load of the cable 1. A suitable cable end connection for synthetic fibre cables 1 has already become known through the PCT/CH94/00044.

Figure 2 shows a perspective illustration of the build-up of the synthetic fibre cable 1 according to the invention. The strands 4, which are twisted or laid of aramide fibres 5, are laid inclusive of the filler

strands 4 left-handedly or right-handedly in layers around a core 10. The friction-reducing intermediate sheathing 7 is arranged between an inner and the outermost strand layer 3. The outermost strand layer 3 is covered by the sheathing 2. The surface 11 of the sheathing 2 can be executed to be structured for determination of a defined co-efficient of friction. The task of the sheathing 2 consists in assuring the desired co-efficient of friction relative to the drive pulley and to protect the strands 4 against mechanical and chemical damages and ultraviolet rays. The load is carried exclusively by the strands 4. The cable 1 built up of aramide fibres 5 by comparison with a steel cable displays a substantially higher carrying capacity and only one fifth to one sixth of the specific weight for the same cross-section. For the same carrying capacity, the diameter of a synthetic fibre cable 1 can therefore be reduced by comparison with a conventional steel cable. Through the use of the aforementioned materials, the cable 1 is protected entirely against corrosion. A maintenance as for steel cables, for example in order to grease the cables, is no longer necessary.

Another form of embodiment of the synthetic fibre cable 1 consists in the different design of the sheathing 2. Instead of using a sheathing 2 enclosing the entire outermost stand layer 3, each individual strand 4 is provided with a separate, annularly closed casing, preferably of polyurethane or polyaramide. The further build-up of the synthetic fibre cable 1, however, remains identical with the form of embodiment described in Fig. 1 and Fig. 2.

Figure 3 shows a schematic illustration of a lift plant. A cage 13 guided in a lift shaft 12 is driven by way of the synthetic fibre cable 1 according to the invention by a drive motor 14 with a drive pulley 15. A counterweight 16 hangs as balancing organ at the other end of the cable 1. The co-efficient of friction between the cable 1 and the drive pulley 15 is now so designed that a further conveying of the cage 13 is prevented when the counterweight 16 has set down on a buffer 17. The fastening of the cable 1 at the cage 13 and at the counterweight 16 takes place by way of cable end connections 18.

When the drive in the case of the use of a linear motor is mounted at the counterweight or at the cage, the co-efficient of friction between the cable 1 and a deflecting pulley shall be as small as possible in order to keep the frictional losses low. The deflecting pulley in this case transmits no driving torque to the cable 1. For this purpose, the

sheathing 2 can in place of polyurethane also be produced of polyamide for a reduction of the co-efficient of friction.

Figure 4 shows a schematic illustration of a lift plant with a suspension of 2:1. Cable end connections 18 for the synthetic fibre cable 1 are in this arrangement not mounted at the cage 13 and at the counterweight 16, but each time at the upper shaft end 19.

Figure 5 shows the synthetic fibre cable 1 according to the invention on the drive pulley 15 in cross-section. The shape of a groove 20 of the drive pulley 18 coupled to the drive motor 14 of the lift is preferably semicircular for an optimum snug contact of the cable 1. Since the cable 1 deforms somewhat under loading on the bearing surface, an oval groove shape can also be chosen. These simple groove shapes can be used, because the synthetic material casing 2 produces a sufficiently high co-efficient of friction. At the same time, by reason of the high co-efficients of friction, the looping angle of the cable 1 at the drive pulley 15 lets itself be reduced. Groove shape of the drive pulley 15 can be constructed identically for lifts of different loads, since the co-efficient of friction is determined by the surface structure 11 and the material of the sheathing 2. Thereby, too great a friction can also be reduced in the individual case in order to prevent a load conveying with the counterweight set down (set-down test). In addition, the drive pulley 15 can be reduced in its dimensions by reason of the lower cable diameter of the synthetic fibre cable 1 and the smaller possible drive pulley diameter connected therewith. A smaller drive pulley diameter leads to a smaller driving torque and thereby to a smaller motor size. The production and inventory of the drive pulleys 15 is also simplified and cheapened substantially. Due to the large bearing surface of the cable 1 in the groove 20, smaller areal pressures likewise arise, which appreciably prolongs the service life of the cable 1 and the drive pulley 15. The cable 1 produced of aramide fibres moreover permits no transmission of the frequencies emanating from the drive pulley 15. Thus, an excitation, which reduces the travelling comfort, of the cable 13 by way of the cable 1 disappears.

Further reductions in the region of the drives let themselves be realised due to the increased co-efficient of friction, the smaller looping angle and the lower weight of the synthetic fibre cable 1. The required starting or running torques and the torques at the shaft of geared machines reduce markedly. Consequently, the starting currents or the entire energy requirement fall. This in turn permits a reduction in the motor and gear sizes and the overall size of the transformers feeding the motors.

Patent Claims:

1. Cable (1) as suspension means for lifts, which is connected with a cage (13) or load-receiving means and driven by way of a drive pulley (15) or a winch, characterised thereby, that carrying strands (4) of synthetic fibres are surrounded by a sheathing (2), which is closed all-round and of synthetic material, preferably of polyurethane.

2. Cable (1) according to claim 1, characterised thereby, that the binding forces between an outermost strand layer (3) and the sheathing (2) are greater than the shear forces arising between the drive pulley (15) and the sheathing (2).

3. Cable (1) according to one of the claims 1 and 2, characterised thereby, that the strands (4) are impregnated by an impregnating medium of specific concentration, in particular polyurethane solution.

4. Cable (1) according to one of the claims 1 and 2, characterised thereby, that the strands (4) are surrounded by a braided sleeve of polyester fibres.

5. Cable (1) according to one of the claims 1 to 4, characterised thereby, that a friction-reducing intermediate sheath (7) is arranged between the outermost strand layer (3) and an inner strand layer (6).

6. Cable (1) according to one of the claims 1 to 4, characterised thereby, that the strands (4) of an inner strand layer (6) are treated with silicone.

7. Cable (1) according to one of the claims 1 to 6, characterised thereby, that the surface (11) of the sheathing (2) is executed to be smooth.

8. Cable (1) according to one of the claims 1 to 6, characterised thereby, that the surface (11) of the sheathing (2) is structured.

9. Cable (1) according to one of the claims 1 to 8, characterised thereby, that the strands (4) are twisted out of aramide fibres (5).

10. Cable (1) according to one of the claims 1 to 8, characterised thereby, that the strands (4) are laid out of aramide fibres (5).

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Fig. 1

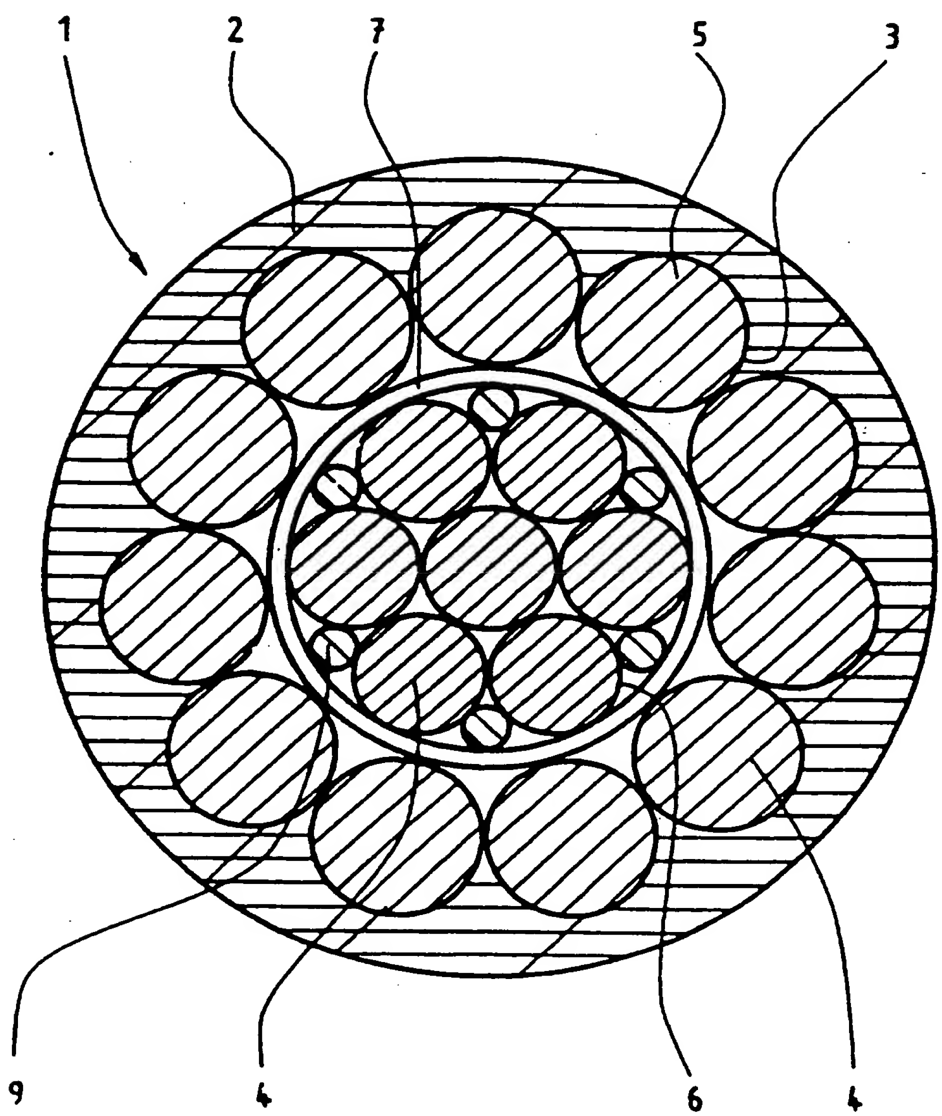

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Fig. 2

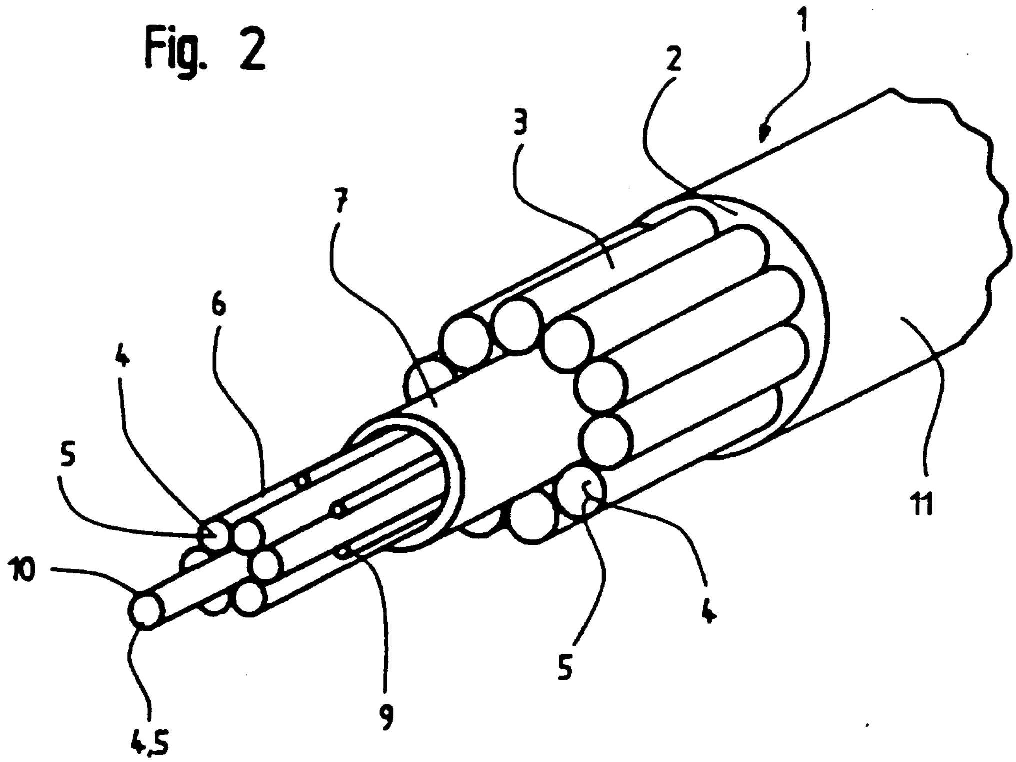

Fig. 4

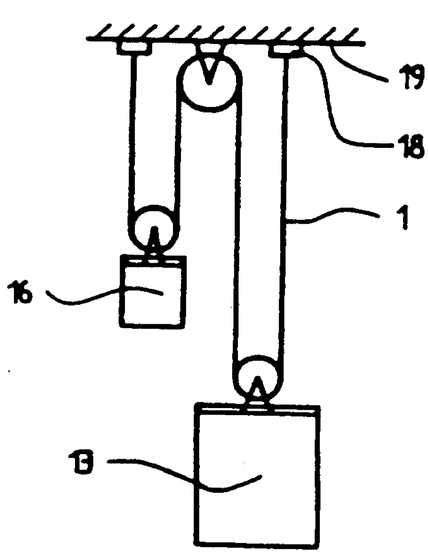

Fig. 5

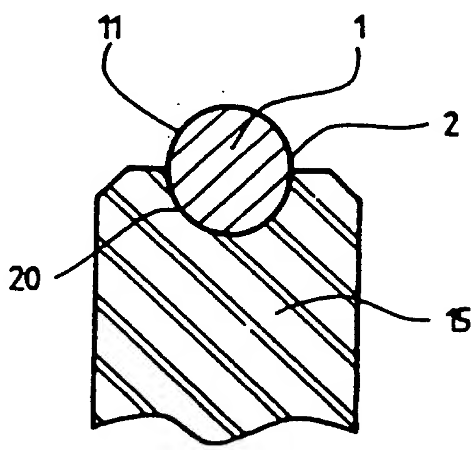

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Fig. 3